This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`

551.2279
O19o

F. Omori

Note on the San Francisco earthquake of April 18, 1906.

Pub. Earthquake Investigation Committee in Foreign Languages, no. 21, Appendix II.

Tokyo, 1906.

The Branner Geological Library

LELAND·STANFORD·JVNIOR·VNIVERSITY

J. C. Branner

NOTE ON THE SAN FRANCISCO EARTHQUAKE OF APRIL 18, 1906.

BY

F. OMORI, D. Sc.

Publications of the Earthquake Investigation Committee in Foreign Languages, No. 21. Appendix II.

TOKYO 1906.

237750

NOTE ON THE

San Francisco Earthquake of April 18, 1906.

BY

F. OMORI, D. Sc.,

Professor of Seismology in the Tokyo Imperial University
and Member of the Imperial Earthquake Investigation Committee.

The different horizontal and vertical micro-seismographs in the Seismological Institute, Tokyo, indicated on the night of April, 18, 1906, a very great disturbance due to a distant origin, which was soon identified with the great San Francisco earthquake. One of the east-west component seismograms is reproduced in the accompanying Plate; the particulars of the Omori Horizontal Pendulum by which the record was obtained being as follows:—

Weight of the heavy mass = 16.5 kg.

Vertical height between the point of suspension and the point of support = 1 metre.

Length of the strut, or the horizontal distance between the point of support and the centre of the heavy bob = 0.75 metre.

Natural period of oscillation of the horizontal pendulum = 41.5 sec.

Multiplication ratio of the writing index = 30.

The time of commencement in Tokyo of the earthquake was $10^h\ 24^m35^s$ p.m. (Japan Standard Time, or the time of long. 135° E. of Greenwich); the total duration being about 5 hours. The duration ($=y_1$) of the "1st preliminary tremor" was 9^m49^s, from which the approximate arcual distance ($=x$) between the origin of the earthquake and the observing place may be calculated,* as follows:—

$$x^{km} = 17.1\ y_1^{sec.} - 1360^{km} = 8700^{km}.$$

* See the *Publications of the Earthquake Inv. Com. in Foreign Languages*, No. 5., p. 63.

If we assume the central point of the epifocal region to be off the coast of San Francisco, say, at *lat.* 37° N, *long.* 124° W, then the arcual distance between Tokyo and the origin of disturbance comes out to be about 8200^{km}.

The 1st displacement of the well-defined horizontal vibration at the very commencement of the "2nd preliminary tremor" was 2.2 mm, directed towards S 27° W; the 2nd displacement, which was much greater, being 4.6 mm, directed towards NE. It will be observed that the directions of these displacements are approximately equal to the direction of the great circle joining Tokyo with the origin of disturbance, namely, SW—NE.

At about 0^h 31^m a.m., on the 19th, namely, 2^h 6^m 35^s after the commencement of the disturbance, there began vibrations which correspond to the same earthquake motion propagated along the major arc of the earth, namely, which was propagated from the centre in a south-western direction, through South America, the Atlantic, and the Indian Ocean.

The time ($=t_0$) of occurrence at the origin of the earthquake may approximately be calculated, from the observations made in Tokyo, by the following formula:—

$$t_0 = t - 1.165\ y_1\ ,$$

where y_1 has the same meaning as before, and t denotes the time of earthquake occurrence observed in Tokyo; $1.165\ y_1 = 11^m30^s$ being the time interval taken by the very first tremors of the earthquake in travelling the distance between Tokyo and the origin of disturbance. We thus find that the time of occurrence at the origin of the shock was about 10^{h}13^{m}5^s p.m. (in Japan Time), or 5^{h}13^{m}5^s a.m. in Western States Time (time of 120° W). The time of earthquake occurrence at San Francisco itself was probably about 5^{h}13^{m}30^s a.m.

The earthquake has been recorded with horizontal pendulums at several other places in Japan. The time ($=t$) of occurrence of the motion and the duration ($=y_1$) of the 1st preliminary tremor at some of the different stations were as follows:—

Mizusawa (province of Rikuchu): $t = 10^{h}24^{m}07^{s}$; $y_1 = 9^{m}07^{s}$
Osaka ..... $t = 10.24.24$; $y_1 = 9.49$
Kobe ..... $t = 10.24.23$; $y_1 = 9.56$

TOKYO. APRIL 25, 1906.

Stanford University Libraries
3 6105 017 471 231

STANFORD UNIVERSITY LIBRARY

To avoid fine, this book should be returned on or before the date last stamped below.

MR 6'53

MAR 15 1965

Stanford University Libraries
3 6105 017 471 231

237